

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application.

Listing of Claims:

Claim 1 (Withdrawn): A projection exposure apparatus which irradiates a pattern formed on a mask with a predetermined exposing energy beam and which projects an image of the pattern on the mask onto a substrate through a projection optical system, comprising:

an attenuation factor characteristic storage system which stores a fluctuation in an attenuation factor of the projection optical system in accordance with a total entered energy entering into the projection optical system; and

an attenuation factor acquisition system connected to the storage to calculate the total entered energy entering into the projection optical system through the mask and to acquire an attenuation factor of the projection optical system upon exposure on the basis of a value of the total entering energy and on the fluctuation in the attenuation factor thereof stored in the attenuation factor characteristic storage system.

Claim 2 (Withdrawn): The projection exposure apparatus as claimed in claim 1, wherein:

the fluctuation in the attenuation factor is a function of the value of the total entered energy entering into the projection optical system through the mask.

Claim 3 (Withdrawn): The projection exposure apparatus as claimed in claim 1, wherein:

the total entered energy entering into the projection optical system through the mask is calculated on the basis of a transmittance of the mask.

Claim 4 (Withdrawn): The projection exposure apparatus as claimed in claim 1, wherein:

the projection exposure apparatus projects the image of the pattern on the mask onto the substrate by relatively scanning the mask with the exposing energy beam.

Claim 5 (Withdrawn): The projection exposure apparatus as claimed in claim 4, wherein:

the total entered energy entering into the projection optical system through the mask is calculated by using information on a relative position of the exposing energy beam and the mask.

Claim 6 (Withdrawn): The projection exposure apparatus as claimed in claim 4, wherein:

the information on the relative position is an optical characteristic of the mask in accordance with the relative position of the exposing energy beam and the mask.

Claim 7 (Withdrawn): The projection exposure apparatus as claimed in claim 6, wherein:

the optical characteristic of the mask contains a characteristic of the transmittance of the mask.

Claim 8 (Withdrawn): The projection exposure apparatus as claimed in claim 1, further comprising:

an entering energy measurement system disposed on a path of the exposing energy beam to measure the total entered energy entering into the projection optical system through the mask.

Claim 9 (Withdrawn): The projection exposure apparatus as claimed in claim 8, further comprising:

a leaving energy measurement system disposed on the path of the exposing energy beam to measure a leaving energy leaving from the projection optical system.

Claim 10 (Withdrawn): The projection exposure apparatus as claimed in claim 9, wherein:

the fluctuation in the attenuation factor is given on the basis of results of measurement of the entering energy measurement system and the leaving energy measurement system.

Claim 11 (Withdrawn): The projection exposure apparatus as claimed in claim 8, wherein: the entering energy measurement system measures the total entered energy entering into the projection optical system through the mask in a state in which the exposing energy beam and the mask are transferred relatively to each other.

Claim 12 (Withdrawn): The projection exposure apparatus as claimed in claim 8, wherein: the projection exposure apparatus is to project the image of the pattern formed on the mask on the substrate by relatively scanning the mask with the exposing energy beam; and the total entered energy entering into the projection optical system through the mask is measured

while relatively scanning the mask with the exposing energy beam in a manner like upon exposure.

Claim 13 (Withdrawn): The projection exposure apparatus as claimed in claim 1, further comprising:

an exposure control system connected to the storage system to control an exposure quantity to be provided on the substrate on the basis of the fluctuation in the attenuation factor.

Claim 14 (Withdrawn): The projection exposure apparatus as claimed in claim 13, wherein: the attenuation factor characteristic storage system stores an attenuation factor of the projection optical system for the total entering energy as well as a fluctuation in the attenuation factor of the projection optical system for an elapsed time after suspension of irradiation of the projection optical system with the exposing energy beam.

Claim 15 (Withdrawn): The projection exposure apparatus as claimed in claim 14, wherein: the attenuation factor of the projection optical system is given on the basis of two kinds of fluctuations in the attenuation factor stored in the attenuation factor characteristic storage system, the total entered energy entering into the projection optical system, and the elapsed time.

Claim 16 (Withdrawn): The projection exposure apparatus as claimed in claim 15, wherein: the exposure quantity to be provided on the substrate is controlled on the basis of the given attenuation factor.

Claim 17 (Withdrawn): The projection exposure apparatus as claimed in claim 4, further comprising:

a stage system which transfers each of the mask and the substrate;

wherein the mask and the substrate are scanned through the stage system in synchronization with the projection optical system upon exposure.

Claim 18 (Withdrawn): The projection exposure apparatus as claimed in claim 1, wherein: the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 19 (Withdrawn): A projection exposure apparatus which irradiates a pattern formed on a mask with a predetermined exposing energy beam and which projects an image of the pattern on the mask onto a substrate through a projection optical system, comprising:

an attenuation factor characteristic storage system which stores a fluctuation in an attenuation factor of the projection optical system in accordance with a total entered energy entering into the projection optical system through the mask.

Claim 20 (Withdrawn): The projection exposure apparatus as claimed in claim 19, wherein: the fluctuation in the attenuation factor is a function of a value of the total entered energy entering into the projection optical system through the mask.

Claim 21 (Withdrawn): The projection exposure apparatus as claimed in claim 19, wherein: the total entered energy entering into the projection optical system through the mask is calculated on the basis of a transmittance of the mask.

Claim 22 (Withdrawn): The projection exposure apparatus as claimed in claim 19, wherein:

the projection exposure apparatus projects the image of the pattern on the mask onto the substrate by relatively scanning the mask with the exposing energy beam.

Claim 23 (Withdrawn): The projection exposure apparatus as claimed in claim 22, wherein:

the total entered energy entering into the projection optical system through the mask is calculated by using information on a relative position of the exposing energy beam and the mask.

Claim 24 (Withdrawn): The projection exposure apparatus as claimed in claim 22, wherein: the information on the relative position is an optical characteristic of the mask in accordance with the relative position of the exposing energy beam and the mask.

Claim 25 (Withdrawn): The projection exposure apparatus as claimed in claim 24, wherein: the optical characteristic of the mask contains a characteristic of the transmittance of the mask.

Claim 26 (Withdrawn): The projection exposure apparatus as claimed in claim 19, further comprising:

an entering energy measurement system disposed on a path of the exposing energy to measure the total entered energy entering into the projection optical system through the mask.

Claim 27 (Withdrawn): The projection exposure apparatus as claimed in claim 26, wherein:

the entering energy measurement system measures the total entered energy entering into the projection optical system through the mask in a state in which the exposing energy beam and the mask are transferred relatively to each other.

Claim 28 (Withdrawn): The projection exposure apparatus as claimed in claim 27, wherein: the projection exposure apparatus is to project the image of the pattern formed on the mask onto the substrate by relatively scanning the mask with the exposing energy beam; and the total entered energy entering into the projection optical system through the mask is measured while relatively scanning the mask with the exposing energy beam in a manner like upon exposure.

Claim 29 (Withdrawn): The projection exposure apparatus as claimed in claim 19, wherein: the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 30 (Withdrawn): A method for manufacturing a projection exposure apparatus which irradiates a pattern formed on a mask with a predetermined exposing energy beam and which projects an image of the pattern formed on the mask onto a substrate through a projection optical system, said method is characterized by the steps of:

installing an attenuation factor characteristic storage system which stores a fluctuation in an attenuation factor of the projection optical system in accordance with a total entered energy entering into the projection optical system; and

installing an attenuation factor acquisition system connected to the storage to calculate a total entered energy entering into the projection optical system through the mask and which

acquires an attenuation factor of the projection optical system upon exposure on the basis of a value of the total entering energy and on the fluctuation in the attenuation factor thereof stored in the attenuation factor characteristic storage system.

Claim 31 (Withdrawn): The method for manufacturing the projection exposure apparatus as claimed in claim 30, wherein:

a substrate is formed by using the projection exposure apparatus manufactured by the method.

Claim 32 (Withdrawn): The manufacturing method as claimed in claim 30, wherein:

the fluctuation in the attenuation factor is a function of the value of the total entered energy entering into the projection optical system through the mask.

Claim 33 (Withdrawn): The manufacturing method as claimed in claim 30, wherein:

the total entered energy entering into the projection optical system through the mask is calculated on the basis of a transmittance of the mask.

Claim 34 (Withdrawn): The manufacturing method as claimed in claim 30, wherein:

the total entered energy entering into the projection optical system through the mask is calculated by using information on a relative position of the exposing energy beam and the mask.

Claim 35 (Withdrawn): The manufacturing method as claimed in claim 34, wherein:

the information on the relative position is an optical characteristic of the mask in accordance with the relative position of the exposing energy beam and the mask.

Claim 36 (Withdrawn): The manufacturing method as claimed in claim 35, wherein:

the optical characteristic of the mask contains a characteristic of the transmittance of the mask.

Claim 37 (Withdrawn): The manufacturing method as claimed in claim 30, further comprising:

installing an entering energy measurement system disposed on a path of the exposing energy beam to measure the total entered energy entering into the projection optical system through the mask.

Claim 38 (Withdrawn): The manufacturing method as claimed in claim 30, further comprising:

installing a leaving energy measurement system disposed on a path of the exposing energy to measure the leaving energy leaving from the projection optical system.

Claim 39 (Withdrawn): The manufacturing method as claimed in claim 30, further comprising:

installing an exposure control system connected to the storage system to control an exposure quantity to be provided on the substrate on the basis of the fluctuation in the attenuation factor.

Claim 40 (Withdrawn): The manufacturing method as claimed in claim 30, wherein:

the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 41 (Currently Amended): An exposure method for scanning exposure of a pattern formed on a mask onto a substrate through a projection optical system by moving the mask and substrate relative to an exposing energy beam,

comprising:

~~obtaining~~ determining a function of ~~a fluctuation in~~ an attenuation in transmittance ~~factor~~ of the projection optical system with respect to the exposing energy beam entering through the mask, as well as a function of an attenuation ~~factor~~ recovery in transmittance of the projection optical system after suspension of the exposing energy beam entering into the projection optical system; and

controlling an exposure quantity to be given to the substrate during the scanning exposure based on said obtained functions regarding transmittance.

Claim 42 (Currently Amended): The exposure method as claimed in claim 41, wherein:

said ~~function~~ functions regarding transmittance ~~of the fluctuation in the attenuation factor~~
~~includes~~ include information regarding a transmittance of the mask.

Claims 43 – 45 (Canceled).

Claim 46 (Currently Amended): The exposure method as claimed in claim 41, wherein:

the ~~fluctuation in the attenuation factor~~ transmittance of the projection optical system is measured in a state in which the mask is moved relatively to the exposing energy beam.

Claims 47 and 48 (Canceled).

Claim 49 (Original): The exposure method as claimed in claim 41, wherein:

the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 50 (Withdrawn): A method for manufacturing a circuit device by projecting an image of a pattern formed on a mask onto a substrate through a projection optical system, said method is characterized by the steps of:

coating the substrate with a photosensitive material;

exposing the image of the pattern on the mask to the substrate by controlling an exposure quantity onto the substrate on the basis of the attenuation factor of the projection optical system upon exposure, the attenuation factor being given on the basis of a fluctuation in an attenuation factor of the projection optical system for the total entered energy entering into the projection optical system through the mask and on the total entering energy; and

developing the substrate.

Claim 51 (Withdrawn): The exposure method as claimed in claim 50, wherein:

the total entered energy entering into the projection optical system through the mask is given on the basis of an optical characteristic of the mask in accordance with a relative position of the mask and the exposing energy beam.

Claim 52 (Currently Amended): An exposure method for irradiating a pattern formed on a mask with an exposing energy beam and projecting an image of the pattern formed on the mask onto a substrate through a projection optical system, comprising:

~~obtaining~~ determining a function of ~~a fluctuation in an attenuation~~ in transmittance factor of the projection optical system with respect to the exposing energy beam entering into the projection optical system, as well as a function of an attenuation ~~factor~~ recovery in transmittance of the projection optical system after suspension of the exposing energy ~~beam~~ beam entering into the projection optical system; and

controlling an exposure quantity to be given to the substrate based on said obtained functions regarding transmittance.

Claim 53 (Currently Amended): The exposure method as claimed in claim 52, wherein:

said ~~function~~ functions regarding transmittance ~~of the fluctuation in the attenuation factor~~
~~includes~~ include a transmittance of the mask.

Claim 54 (Currently Amended): The exposure method as claimed in claim 52, wherein:

said ~~function~~ functions regarding transmittance ~~of the fluctuation in the attenuation factor~~
~~includes~~ include a rate of the presence of a pattern on the mask.

Claim 55 (Previously Presented) The exposure method as claimed in claim 53, wherein:

the transmittance of the mask is obtained as a function of a position of the mask in the moved direction relative to the exposing energy beam on the basis of design data of the mask.

Claims 56 – 58 (Canceled).

Claim 59 (Original): The exposure method as claimed in claim 52, wherein:

the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 60 (Withdrawn): A projection exposure apparatus which irradiates a pattern formed on a mask with a predetermined exposing energy beam and which projects an image of the pattern formed on the mask onto a substrate through a projection optical system, comprising:

an attenuation factor characteristic storage system which stores a fluctuation in an attenuation factor of the projection optical system in an elapsed time after suspension of the irradiation of the projection optical system with the exposing energy beam.

Claim 61 (Withdrawn): The projection exposure apparatus as claimed in claim 60, wherein:

the fluctuation in the attenuation factor is approximated as a function of the elapsed time after suspension of the irradiation of the mask with the exposing energy beam.

Claim 62 (Withdrawn): The projection exposure apparatus as claimed in claim 60, wherein:

the attenuation factor characteristic storage system further stores the fluctuation in the attenuation factor of the projection optical system in accordance with the total entered energy entering into the projection optical system.

Claim 63 (Withdrawn): The exposure method as claimed in claim 60, wherein:

the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claim 64 (Withdrawn): A method for manufacturing a projection exposure apparatus which irradiates a pattern formed on a mask with a predetermined exposing energy beam and which projects an image of the pattern formed on the mask onto a substrate through a projection optical system, said method is characterized by the steps of:

installing an attenuation factor characteristic storage system which stores a fluctuation in an attenuation factor of the projection optical system in accordance with an elapsed time after interruption of the irradiation of the projection optical system with the exposing energy beam; and

installing an attenuation factor acquisition system connected to the storage to acquire an attenuation factor of the projection optical system upon exposure on the basis of the fluctuation in the

attenuation factor thereof stored in the attenuation factor characteristic storage system and the elapsed time.

Claim 65 (Withdrawn): The method for manufacturing the projection exposure apparatus as claimed in claim 64, wherein:

a substrate is formed by using the projection exposure apparatus manufactured by the method.

Claim 66 (Withdrawn): The manufacturing method as claimed in claim 64, further comprising:

installing an exposure control system connected to the storage system to control an exposure quantity to be provided on the substrate on the basis of the fluctuation in the attenuation factor.

Claim 67 (Withdrawn): The manufacturing method as claimed in claim 64, wherein:

the exposing energy beam is an energy beam having a wavelength in an ultraviolet region.

Claims 68-71 (Canceled).

Claim 72 (Withdrawn): A method for manufacturing a circuit device by projecting an image of a pattern formed on a mask onto a substrate through a projection optical system, said method is characterized by the steps of:

coating the substrate with a photosensitive material;

exposing the image of the pattern on the mask to the substrate by controlling an exposure quantity on the substrate on the basis of the attenuation factor of the projection optical system, the attenuation factor upon exposure being given on the basis of a fluctuation in an attenuation factor of the projection optical system in a predetermined elapsed time after interruption of exposure of the mask; and

developing the substrate.

Claim 73 (Withdrawn): The exposure method as claimed in claim 72, wherein:

the total entered energy entering into the projection optical system through the mask is given on the basis of an optical characteristic of the mask in accordance with a relative position of the mask and the exposing energy beam.

Claim 74 (Canceled).

Claim 75 (Currently Amended): The exposure method as claimed in claim 42, wherein:

the transmittance ~~the characteristic of the transmittance~~ of the mask is obtained as a function of a position of the mask in the moved direction relative to the exposing energy beam on the basis of design data of the mask.

Claim 76 (Currently Amended): The exposure method as claimed in claim 41, wherein:

the ~~function~~ functions regarding transmittance ~~of the fluctuation in the attenuation factor~~ of the projection optical system is are obtained prior to the scanning exposure and stored in a memory.

Claim 77 (Currently Amended): The exposure method as claimed in claim 76, further comprising:

detecting the exposing energy beam between the light source for emitting the exposing energy beam and the mask,

irradiating the mask with the exposing energy beam in a state in which a light recipient surface of a photo detector is mounted on an imaging plane of the projection optical system, and

obtaining the functions regarding transmittance ~~function of the fluctuation in the attenuation factor~~ of the projection optical system on the basis of a value of the exposing energy beam detected between the light source and the mask and on a value of the exposing energy beam detected by the photo detector in a state in which the mask is moved relatively to the exposing energy beam.

Claims 78 – 82 (Canceled).

Claim 83 (Currently Amended): The exposure method as claimed in claim 41, further comprising:

moving the mask in a first direction relative to the exposure energy beam and in a second direction relative to the exposure energy beam, which differs from the first direction,

obtaining the functions regarding transmittance ~~function of the fluctuation in the attenuation factor~~ in accordance with each of the relative movement of the mask relative in the first direction and the relative movement of the mask in the second direction.

Claims 84 – 89 (Canceled).

Claim 90 (Currently Amended): The exposure method as claimed in claim 52, wherein:

the functions regarding transmittance ~~function of the fluctuation in the attenuation factor~~ of the projection optical system is are obtained prior to projecting the image of the pattern of the mask onto the substrate and stored in memory.

Claim 91 (Currently Amended): The exposure method as claimed in claim 90, further comprising:

detecting the exposing energy beam between the light source of emitting the exposing beam and the mask,

detecting the exposing energy beam after it has passed through the projection optical system, and

obtaining the functions regarding transmittance ~~function of the fluctuation in the attenuation factor~~ of the projection optical system on the basis of the results of both detections.

Claim 92 (Currently Amended): The exposure method as claimed 41, wherein:

the projection optical system is of such a nature that after supply of the exposure energy beam into the projection optical system has stopped, its transmittance ~~when the attenuation factor~~ recovers, ~~the degree of the recovery~~ and then, gradually decreases.

Claim 93 (New): The exposure method as claimed in 52, wherein:

the projection optical system is of such a nature that after supply of the exposure energy beam into the projection optical system has stopped, its transmittance ~~when the attenuation factor~~ recovers, ~~the degree of the recovery~~ and then, gradually decreases.